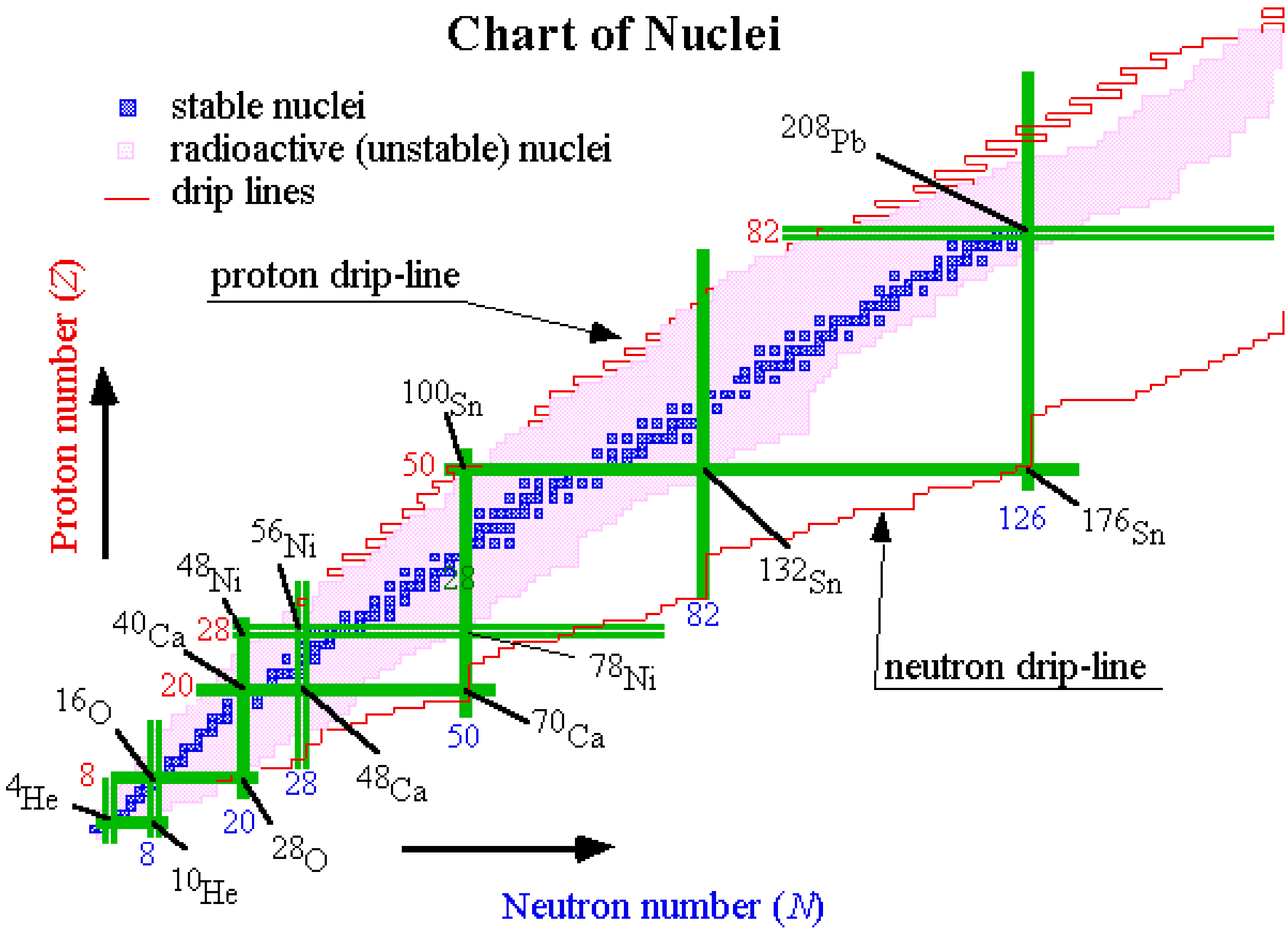
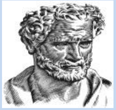
# ISOLDE @ CERN

Anastasios Lagoyannis
Tandem Accelerator Laboratory
Institute of Nuclear and Particle Physics
N.C.S.R. “Demokritos”

# Why RIB's ?



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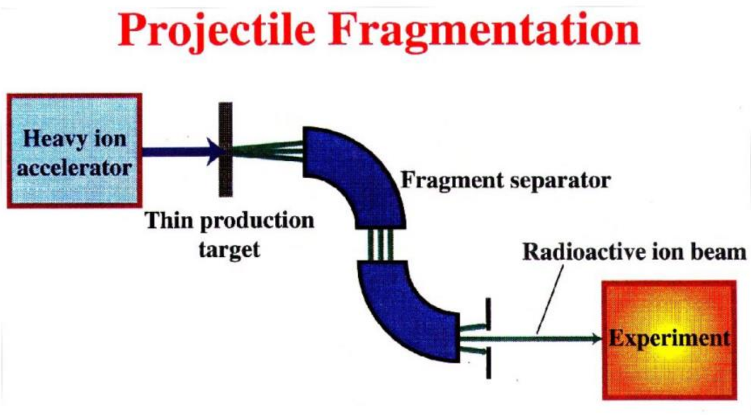
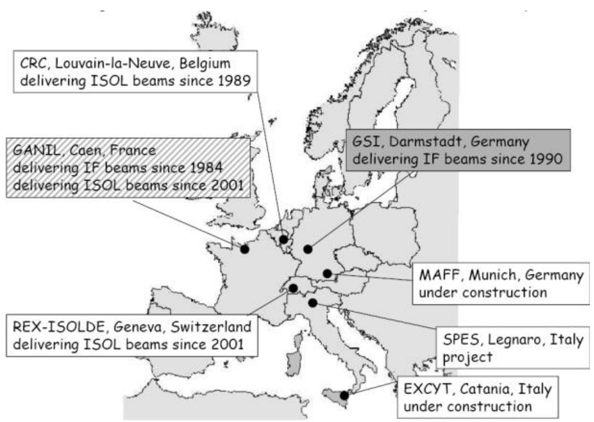
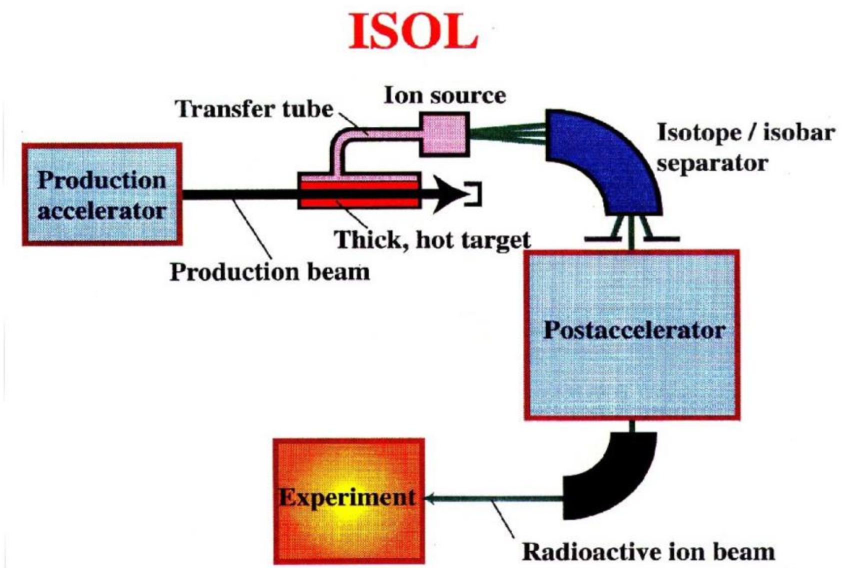
# Production of RIB



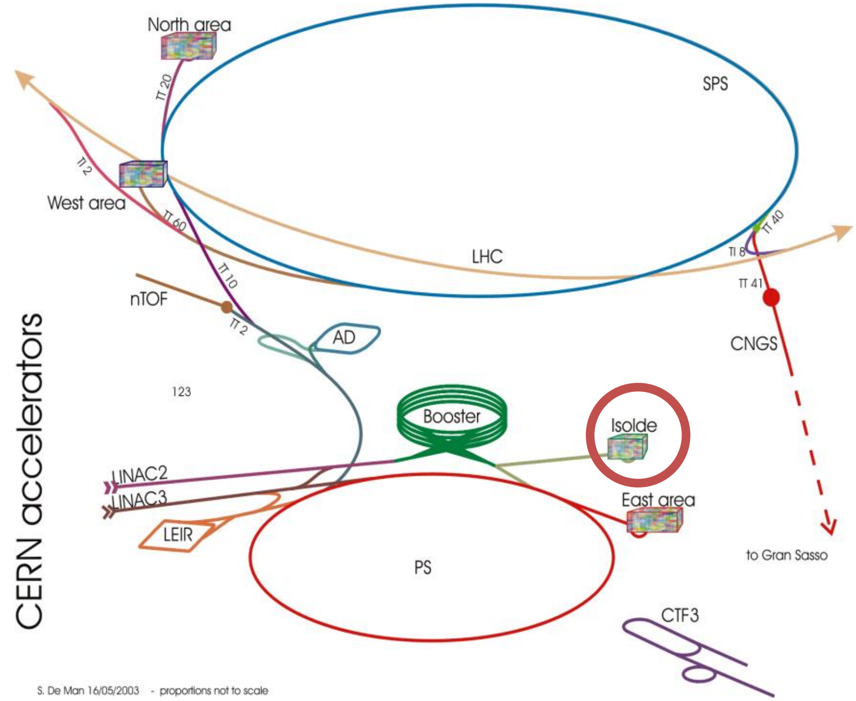

- Time limit ~1 μs
- High luminosity
- High energy beam >100 MeV/u
- No chemistry

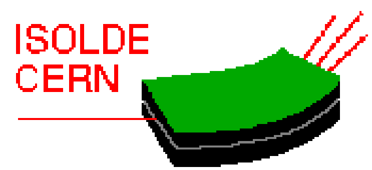



- Time limit ~10-100 ms
- High beam intensity close to stability
- Better beam quality (purity, optics …)
- Nuclei produced at rest

# CERN





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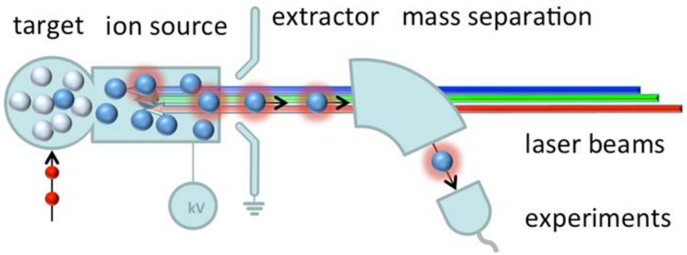
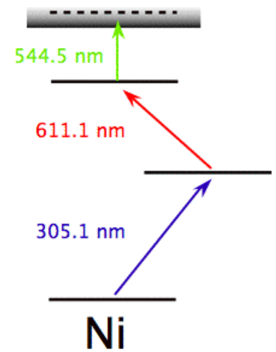
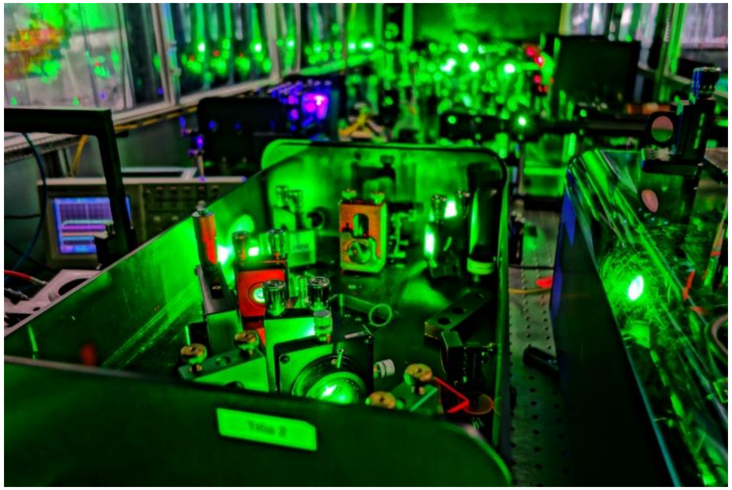
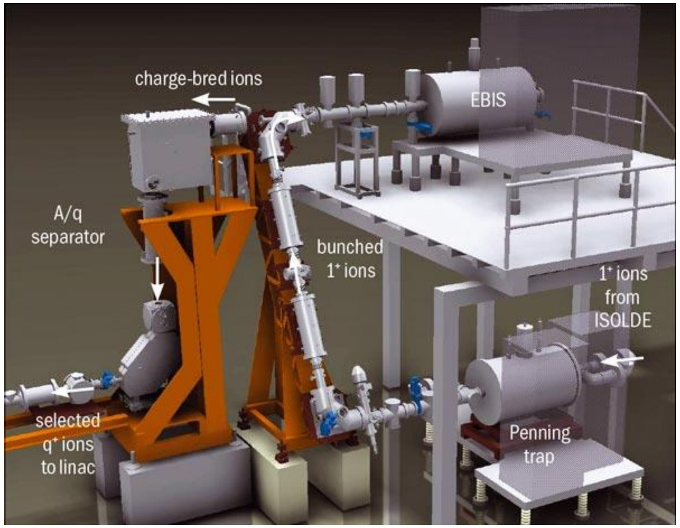
**Resonance Ionization Laser Ion Source**



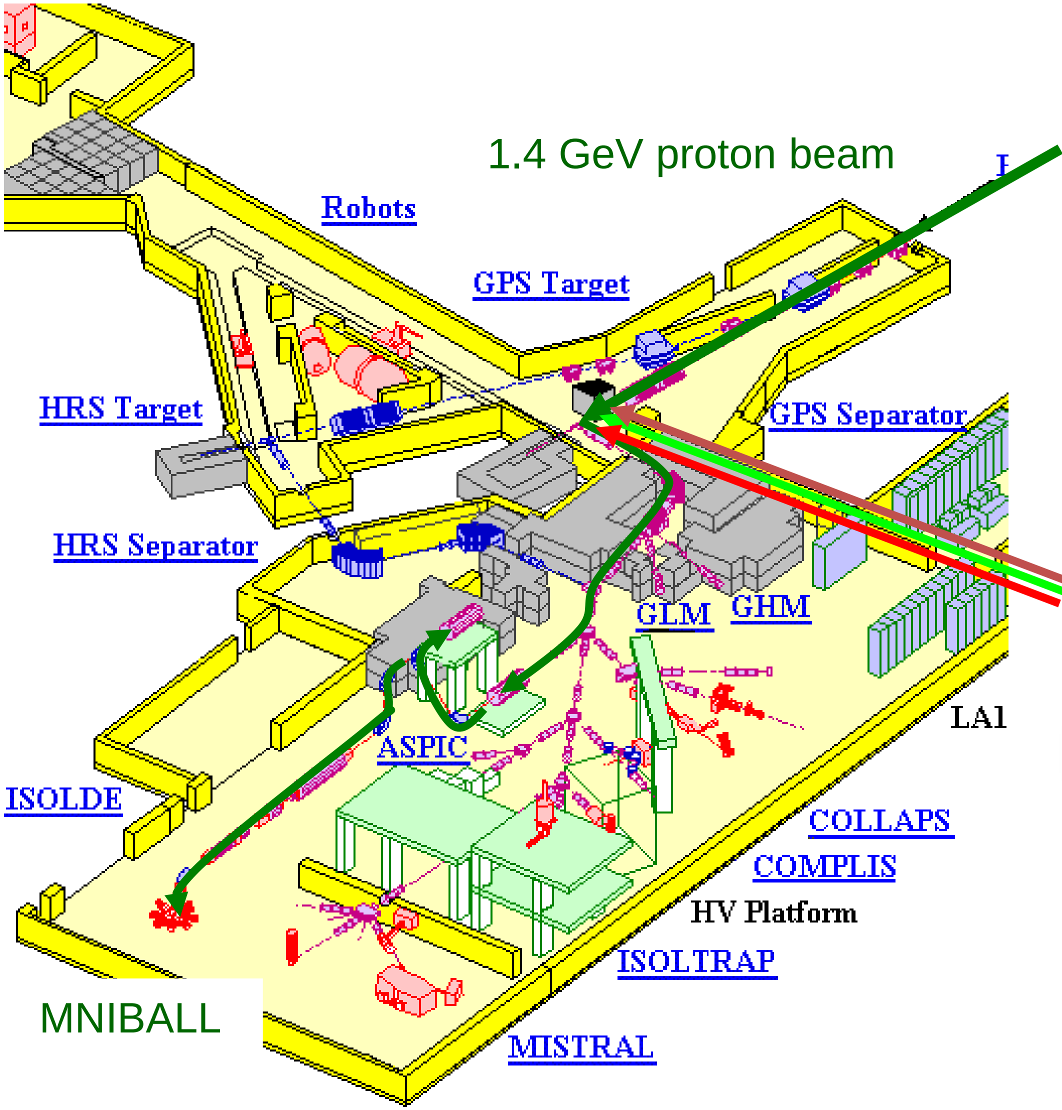


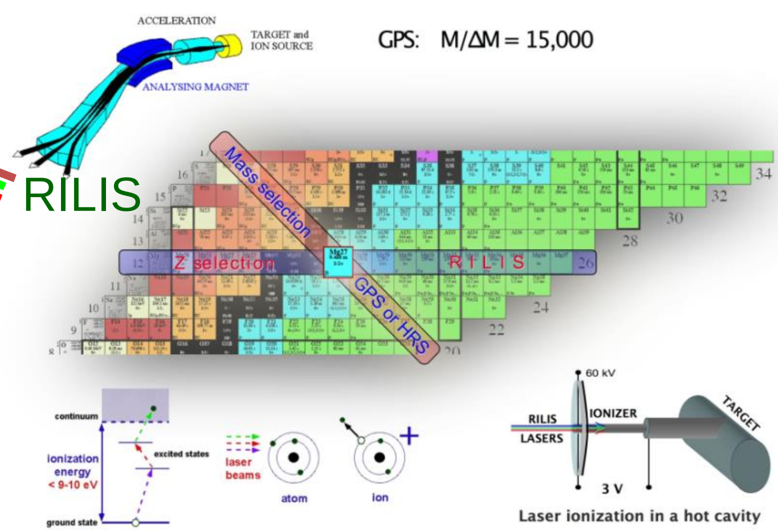

**REXTRAP** — Penning trap, slowing down ions, accumulation and bunching

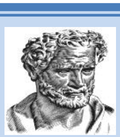
**REXEBIS** — Electron Beam Ion Source
Charge breeding

**Mass separator** — $A/q < 4.5$

# ISOLDE

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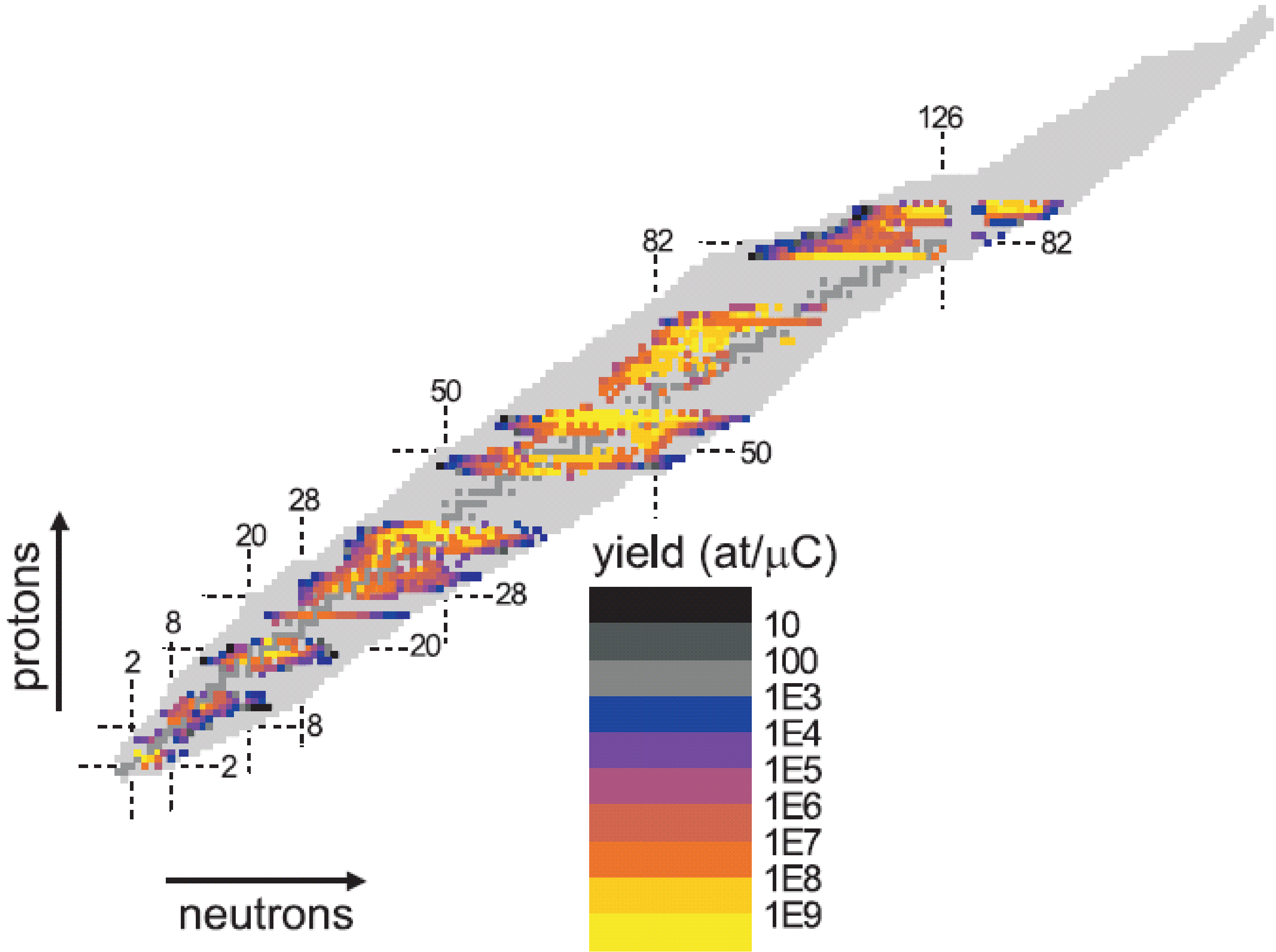
# Yields

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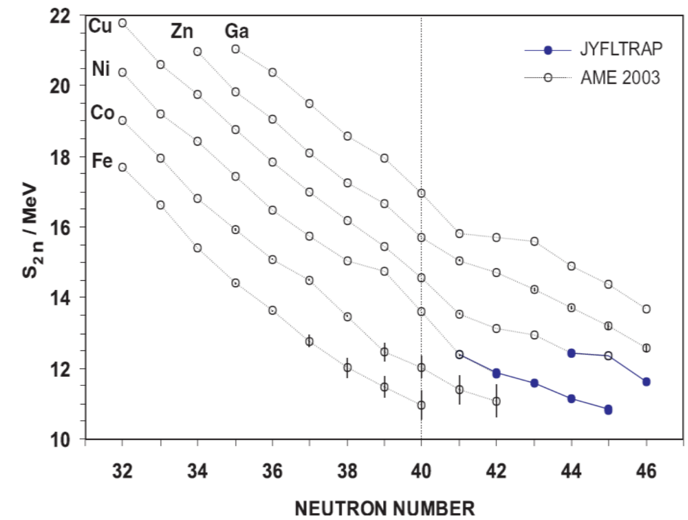
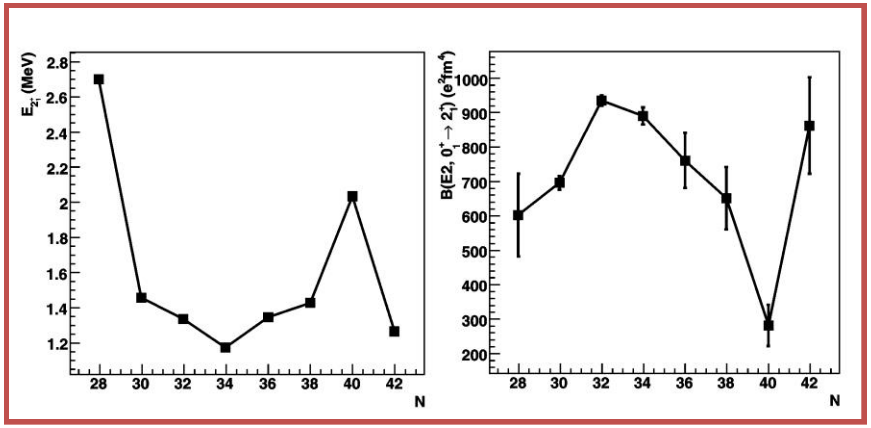
# Physics case: $^{68}Ni$

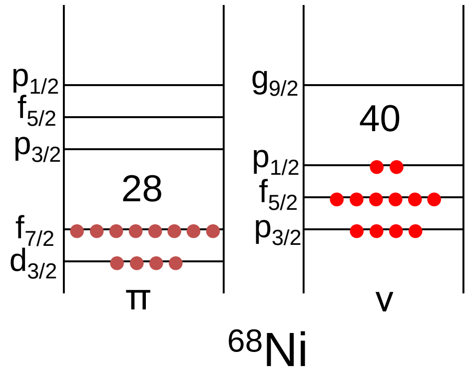
## Is the nature of the N=40 subshell closure understood?

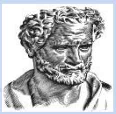
- First excited state $0^+$ at higher energies
- The $2^+$ state at larger excitation energy
- Small $B(E2, 0^+ \rightarrow 2^+)$
- No irregularity at the $S_{2n}$ or at the binding energies
- Fragile nature of the N=40 subshell closure
- Other reasons for the small observed $B(E2, 0^+ \rightarrow 2^+)$




S. Rahaman *et al*., Eur. Phys. J. A 34, 5 (2007)

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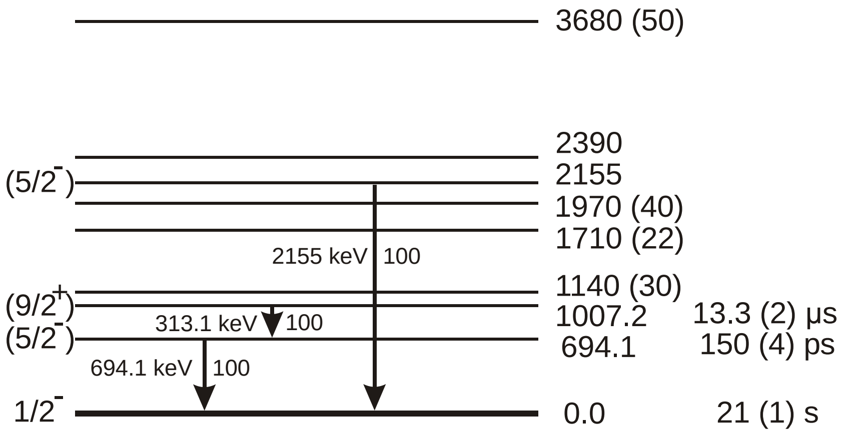
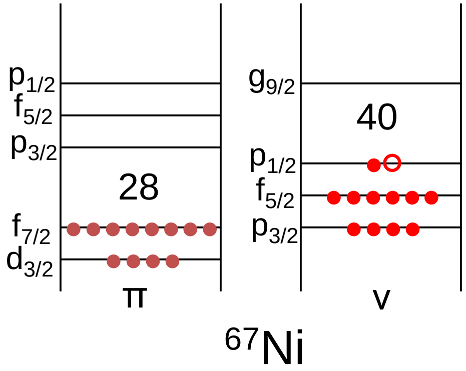
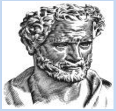
# Study of the single particle character of the neutron rich Ni isotopes

## Physics case: $^{2}$H($^{66}$NI,p)$^{67}$Ni ,Q = 3.583 MeV

- $^{67}$Ni$^{g}$ one hole state of the $^{68}$Ni
- g factor exp. value smaller by a factor of 2 than the expected for $1g_{9/2}$
- Unambiguous determination of the spin and parities of the the first excited states - one more state $v_{3/2}$ not yet observed
- Single particle character of the states of $^{67}$Ni (relative SF's)
- A good starting point as to determine the single particle character of the Ni isotopic chain – single particle systematics



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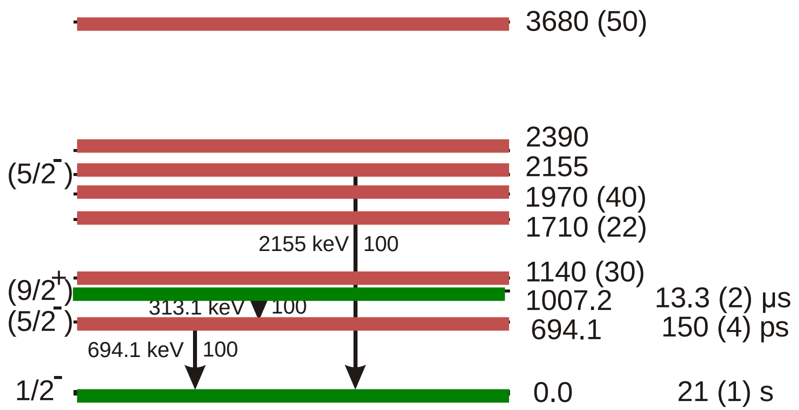
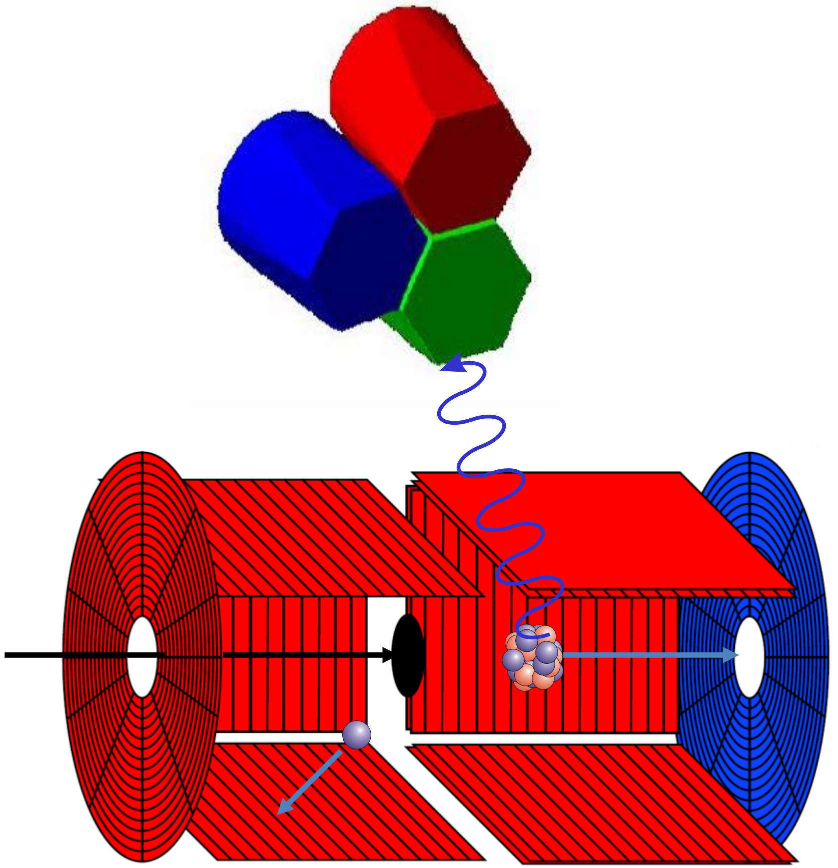
# Experimental Setup

- "Thick" $CD_2$ target measurement (1mgr/cm$^2$)
  - Spectroscopic information for the excited states up to 3 MeV.
  - Coincidences with γ
- "Thin" $CD_2$ target measurement (100 μgr/cm$^2$)
  - Spectroscopic information for the ground and the second excited state.
  - Singles: only backward angles



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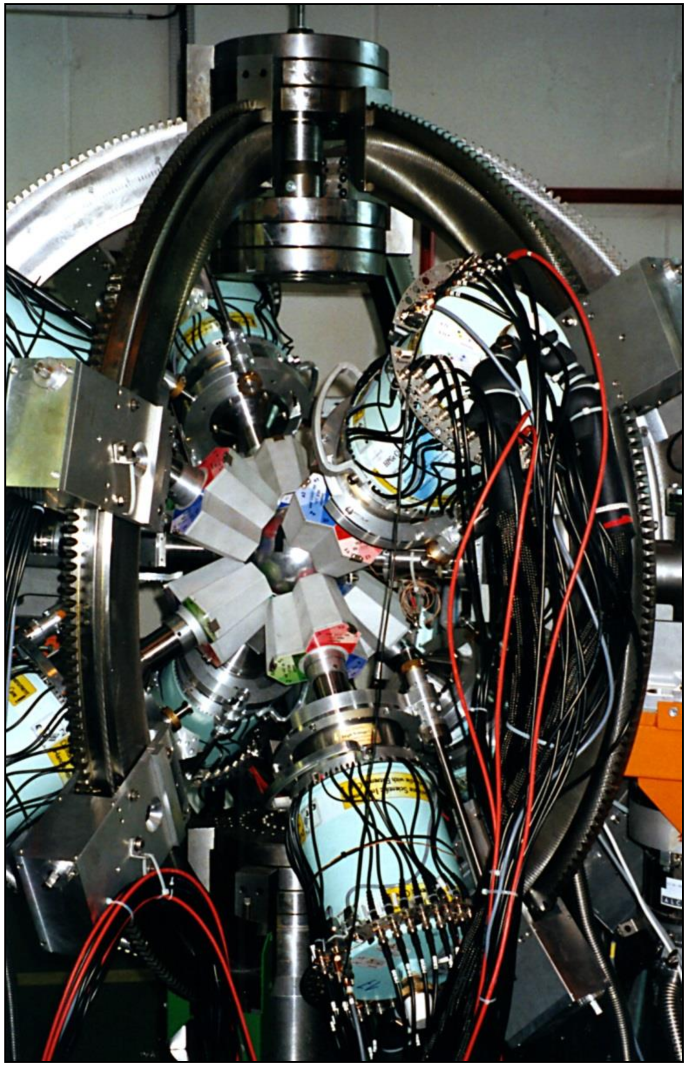
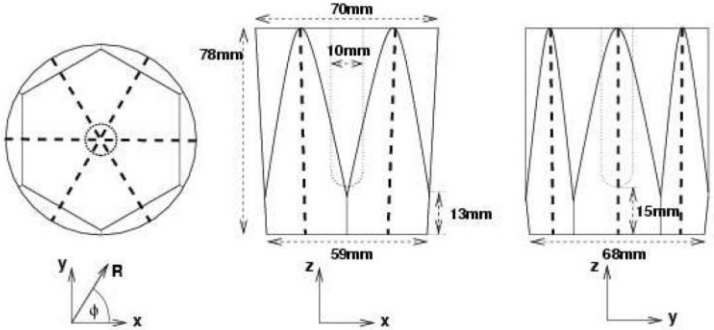
# Miniball



8 x

= 168 channels




ε = 10% @ 1 MeV

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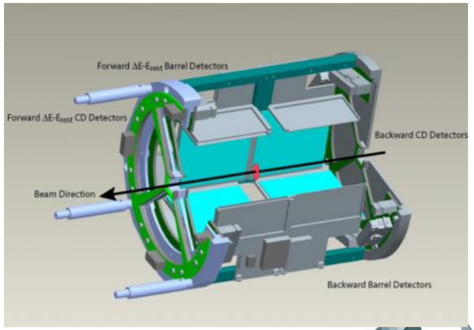
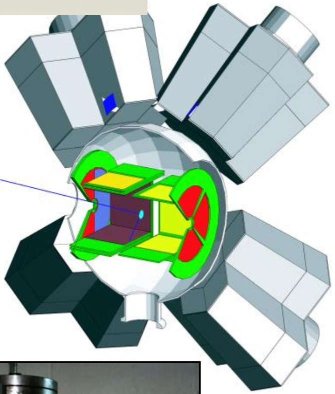
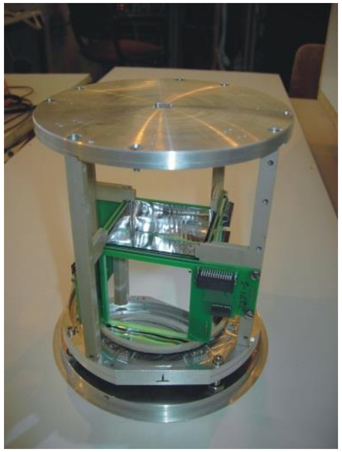
# Silicon Barrel

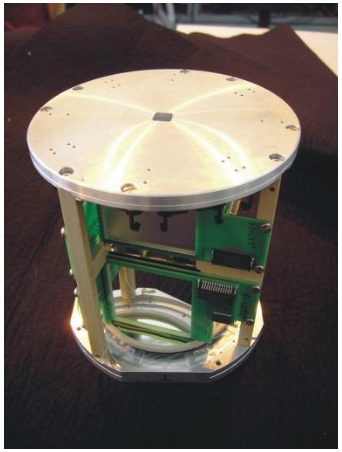
| Detector | Angles | Thickness | Segmentation |
|---|---|---|---|
| Forw. CD (ΔE) | 8-30 | 300 μm | 16 annular x 24 radial |
| Forw. CD (E) | 8-30 | 1.5 mm | no |
| Forw. Barrel (ΔE) | 30-75 | 140 μm | 16 stripes ⊥ beam + ch. Div resistive layer |
| Forw. Barrel (PAD) | 30-75 | 1 mm | no |
| Back. Barrel | 104-152 | 500 μm | 16 stripes ⊥ beam + ch. Div resistive layer |
| Back. CD | 152-172 | 500 μm | 16 annular x 24 radial |

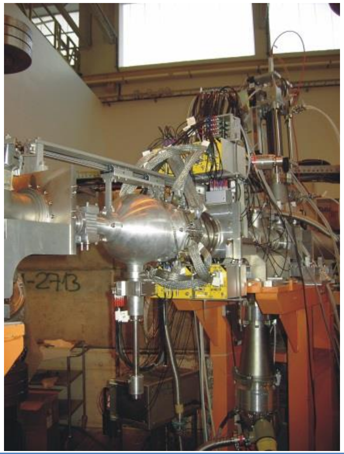


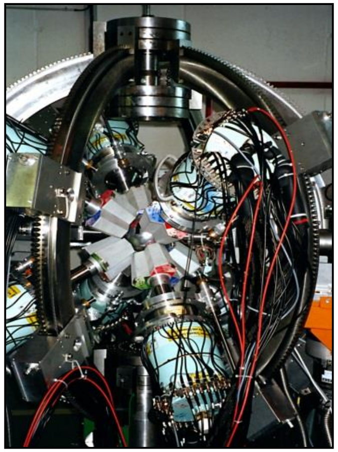



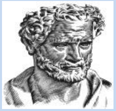
## Particle detector: 464 channels











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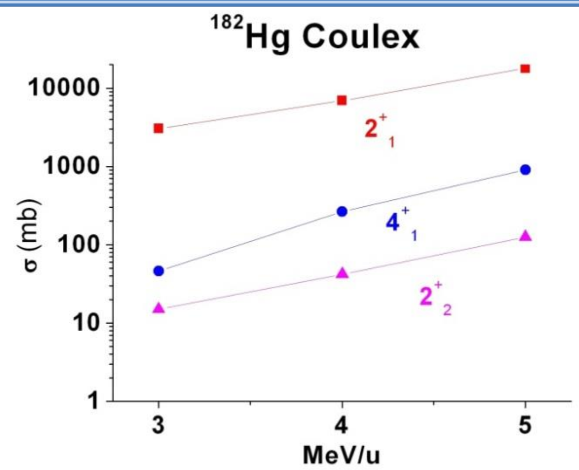
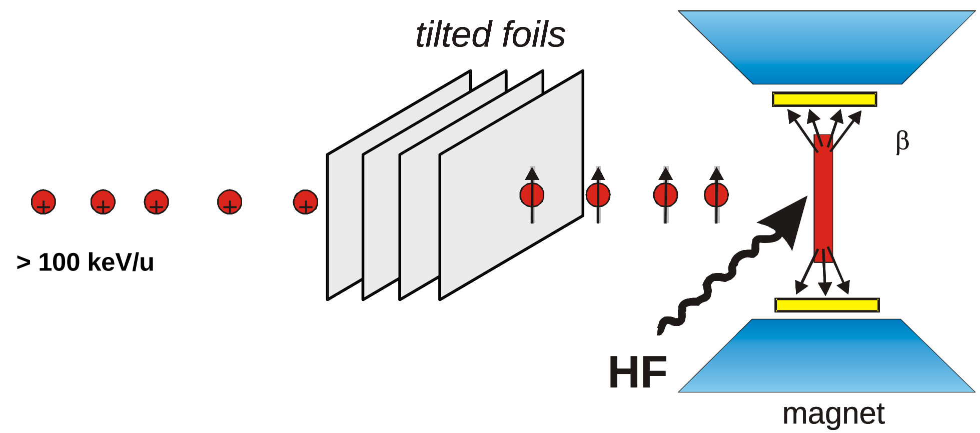
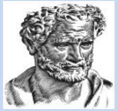
# HIE - ISOLDE

- Intensity
- Energy
  - Coulex for all RIB
  - Transfer reactions
- Efficiency   low energy + accelerated
- Selectivity
- Beam "quality"
  - Reduced phase space
  - Bunching
- Polarization .....

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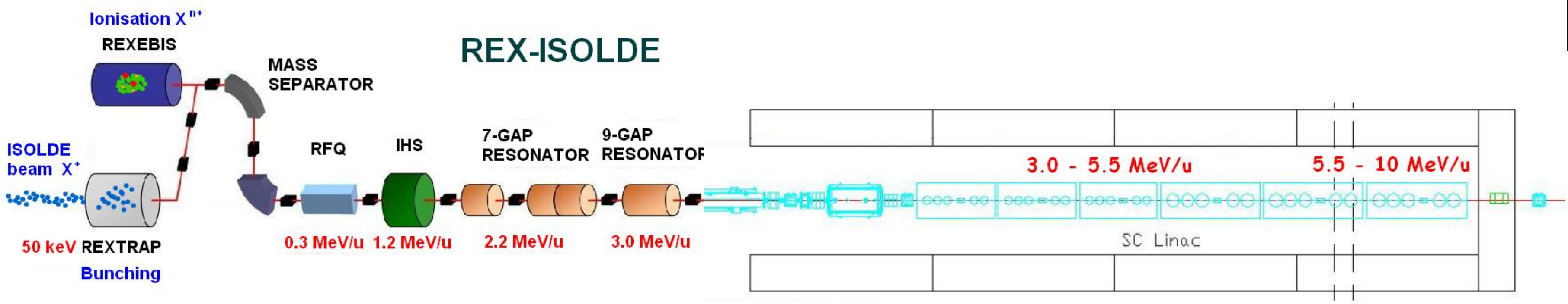
# HIE - ISOLDE

Increase in REX energy from 3 to 10 MeV/u
(first step an increase to 5.5 MeV/u)




**Increase proton intensity 2 → 6 μA (LINAC4, PSB upgrade) - target and front-end upgrade**

RFQ cooler, REX-TRAP, REX-EBIS    REX-ECR upgrades

Super-HRS for isobaric separation
RILIS upgrade & LIST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